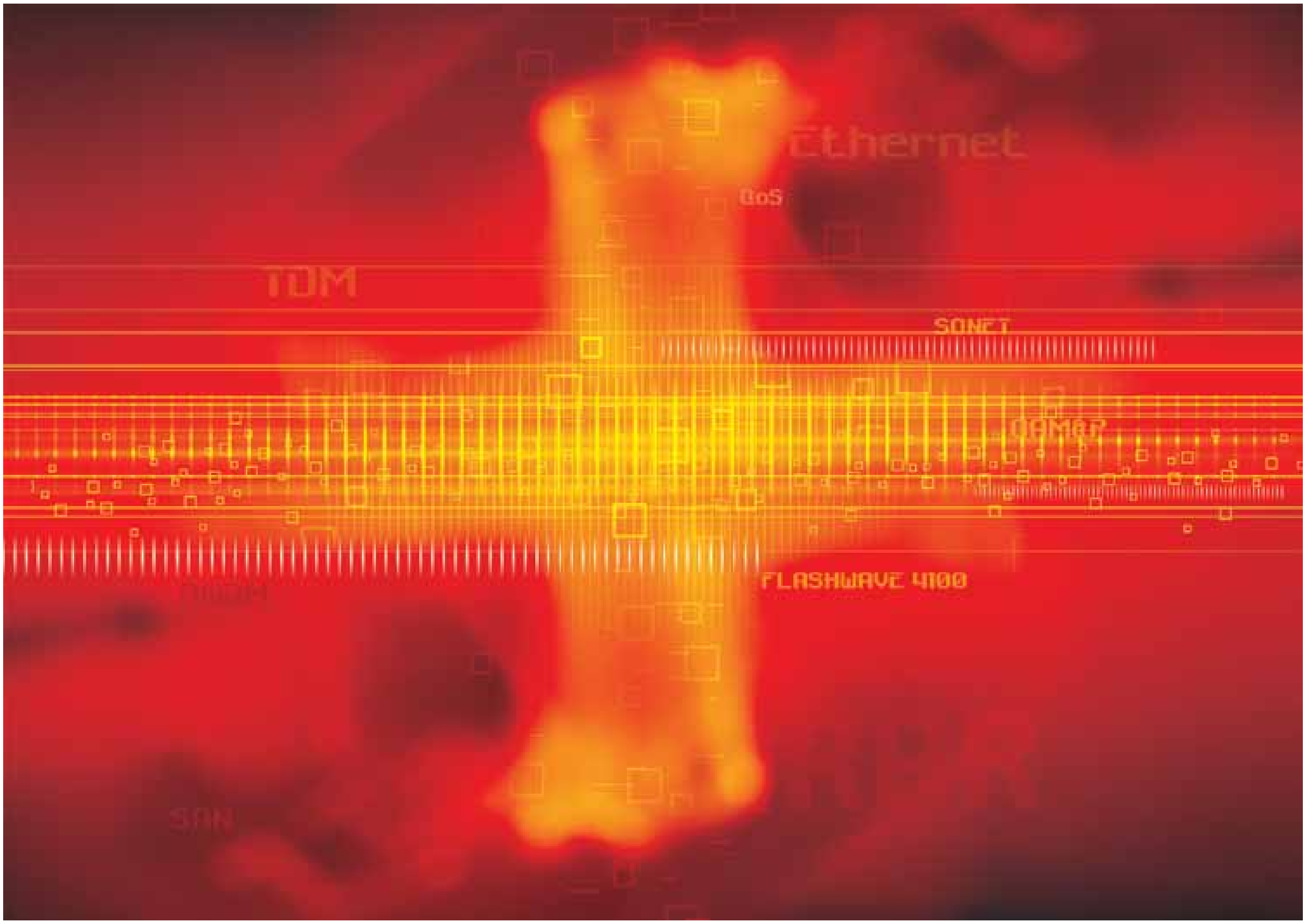
Benefits of RPR for Utility Critical Infrastructure Networks



Introduction

Utility company professionals charged with designing, maintaining and managing survivable communications networks to support CI, are turning to multiservice platforms that support RPR over SONET technology.

RPR over SONET allows convergence between legacy fixed-bandwidth services and new IP-based services without the cost of deploying overlay networks. RPR provides the reliability of SONET with the added benefit of service prioritization, an absolute necessity in CI provider communication networks.

Surviving the Information Revolution

The information age has created an ever-increasing demand for bandwidth access. CI network technicians and administrators constantly demand faster access to more and greater types of data. As in most private and public networks, capacity demand is driving CI communications networks to almost constant growth. Communications engineers must meet the challenge of accommodating that growth reliably and economically.

Field technicians at remote locations demand fast and reliable communication access to support a wide range of technologies. Utility NCC personnel don't have time to learn the "ins and outs" of each new technology. Support for CI networks requires fast, inexpensive and reliable communications delivery to field services. Network control technicians need a point-and-click network management system that:

- Provisions communication services quickly and easily
- Monitors the communications network
- Isolates network troubles regardless of the underlying service layer
- Provides a simple and graphical view of communications network health data

The Utility telecom engineer must intelligently manage a variety of simultaneous requirements, including:

- Delivering required capacity and ease of use
- Foreseeing future demand requirements
- Staying within budget
- Insuring that ROI is being maximized
- Keeping the existing telecom network operating efficiently

Legacy Applications

In the past, communications needs at remote substation and admin sites were minimal. Typical requirements consisted of a few voice, SCADA and protection circuits. These critical, yet low bandwidth services required only a few time slots on a channel bank and a copper, RF or fiber transport link to the next substation or control center. Like telephone service for residential and business customers, these TDM circuits were allotted the same network capacity at all times, whether they were actively transporting data or not.
Most legacy communications circuits required at most 64 kbps of bandwidth. These circuits, even when combined with other circuits, only used a small percentage of a single T1. Capacity was not an issue.

As bandwidth requirements at the substation increase, driven by the need for access to engineering drawings, Internet, e-mail, network management data and trouble tickets, engineers typically add T1 circuits. This satisfies the immediate demand, but deploys even more underused T1 capacity. The additional T1 circuits eventually cause transport system upgrades (OC-1 to OC-3, OC-3 to OC-12, etc.).

New Application Demand

In the utility industry, the substation automation initiative is changing many aspects of CI networks. Migration towards automated substations and IEDs has increased the amount of information and access requirements to and from the substation. Appropriate selection of communication architectures, technology, and protocols can have large impact on the overall lifecycle and business costs associated with such a substation.

Internal data requirements for e-mail, Web access, etc, as well as capacity demand for VoIP, live video surveillance and SAN, have increased demand beyond the capacity of many existing networks.

In some cases, increasing the capacity of the existing TDM system can satisfy these additional services. Other cases might require adding a parallel high-capacity system such as a second SONET system or Ethernet-based WAN overlay.

SONET and other physical optical layers such as Carrier Ethernet, 10/100Base-F, Gigabit Ethernet and SAN protocols such as ESCON, Fibre Channel and FICON can even be stacked together on the same fiber using DWDM or CWDM.

These capacity solutions allocate bandwidth that is relatively rarely used. Most of the demand occurs in bursts that require immediate capacity, but only temporarily. After that temporary need is satisfied, capacity requirements return to the previous level. The bandwidth allocated for data traffic sits idle when users are offline. Precious capital and operating expense money is spent on networks that offer largely unused capacity.

Problem

Utility telecom engineers need to provide flexible bandwidth allocation while minimizing expenses for equipment, training, and operations. Legacy SONET systems cannot detect data surges in the underlying services. How can engineers provide bandwidth for peak demand without deploying multiple systems and expensive overlays?

The answer is RPR over SONET.

RPR compliments standard SONET features by applying protection algorithms and service classification levels to data traffic. RPR accommodates bursts of traffic by using bandwidth that is underutilized from one service and dynamically reallocating it to another.

The Fujitsu FLASHWAVE® Product Family Solution

The Fujitsu FLASHWAVE® 4000 family of MSPP products offers utility companies the ability to leverage their SONET investment and deliver new IP-based services over the same network as traditional TDM services, eliminating the need for a costly network overlay. The FLASHWAVE 4000 MSPP products provide the reliability of SONET and its proven ability to deliver traditional protected TDM services while delivering new packet-based data services. The FLASHWAVE 4100 and FLASHWAVE 4500 products also support RPR interfaces, and can be used to prioritize QoS levels across different applications and protect service accordingly.

Legacy Circuits

The FLASHWAVE 4000 MSPP family accommodates traditional TDM interfaces such as DS1, DS3 and OC-n line rates. These low speed interfaces can be transported over FLASHWAVE products with the inherent SONET UPSR reliability of approximately 1 ms protection switching as shown in Figure 1. UPSR addresses the requirement to continue to provide a redundant protection path for existing communication circuits such as SCADA, transfer/trip, current differential and teleprotection.

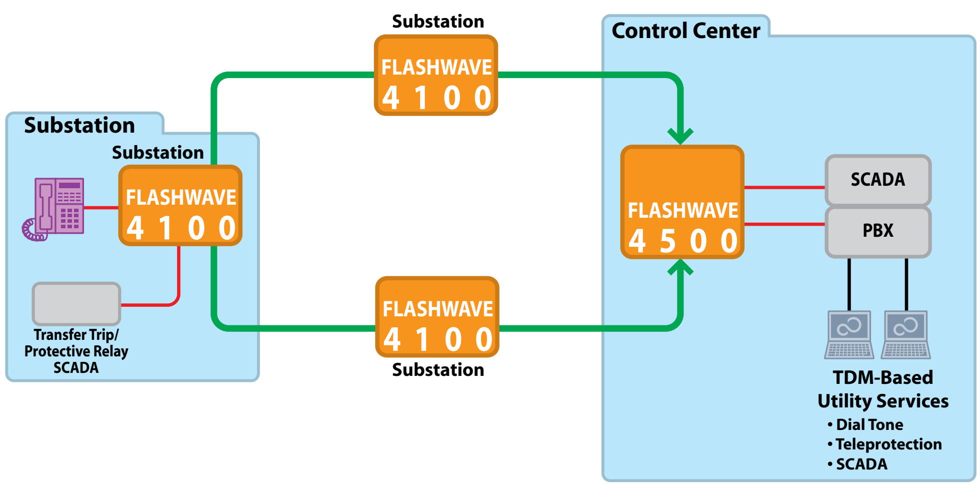


Figure 1: Traditional Utility Network TDM Traffic Flow

These legacy circuits are typically connected to a channel bank, wired to the Fujitsu FLASHWAVE MSPPs, and routed in two directions around the ring. The tail end FLASHWAVE MSPP constantly monitors signal health, and in the event of a service degradation or fiber cut, switches the interface to the alternate path in about 1 ms as shown in Figure 2.

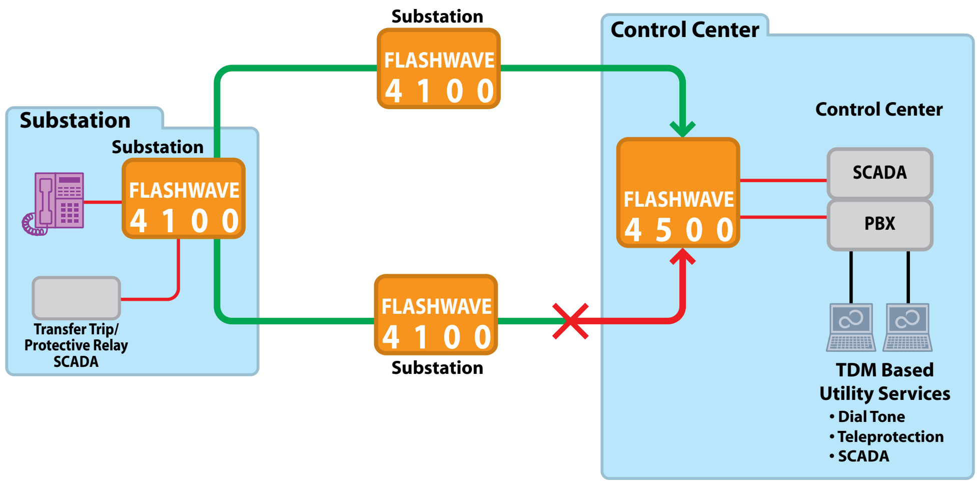


Figure 2: Traditional Utility Network Fiber Failure Condition

New Services

Substation automation is pushing data protocols traditionally found in data centers and office environments out to the substation. VoIP is replacing traditional dial tone provided by a PBX. Ethernet connections are required for remote access to e-mail, Internet and Intranets. Utility providers are deploying IP video surveillance cameras to address physical plant protection and Homeland Security concerns in remote and main substations. Modern SANs resolve complex archiving issues for network drawings, e-mail, trouble tickets, network reliability data and customer records. These new applications generally use Ethernet protocols, and require significant amounts of bandwidth. However this demand occurs in bursts.

The FLASHWAVE 4000 MSPPs offer 10/100/1000 Mbps Ethernet interfaces to deliver these new services over the same reliable SONET network used for TDM services. Bandwidth can be allocated in-service at increments of 1 Mbps up to full Gigabit Ethernet line rates using LCAS, VCAT, and low order VCAT (LO-VCAT). As shown in Figure 3, these bandwidth mapping schemes create optimized pipe sizes for efficient packet data transport.

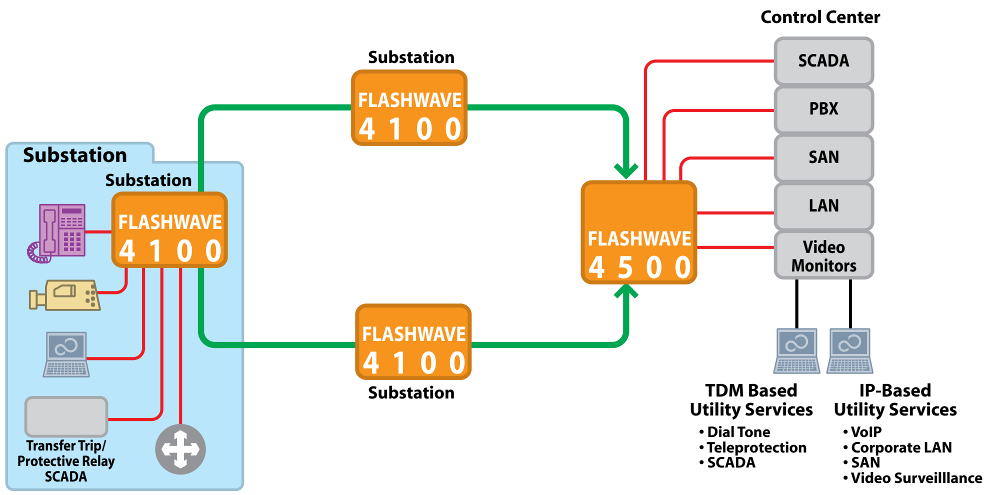


Figure 3: Multiservice Utility Network RPR—Normal Traffic Flow

Combining SONET Reliability with Ethernet Flexibility

The RPR capabilities of the Fujitsu FLASHWAVE 4100 MSPP or FLASHWAVE 4500 MSPP/MSSP allow users to efficiently support intermittent bursts of data and oversubscription along with guaranteed bandwidth using QoS levels for service prioritization. These FLASHWAVE platforms deliver MEF-certified E-Line, EVPL and E-LAN multipoint services that can scale from 1 Mbps to 1 Gbps.

Three QoS classes are available with the FLASHWAVE 4100 MSPP and FLASHWAVE 4500 MSPP/MSSP:

- Class A service is for high-priority traffic that is strictly bound by delay and jitter tolerances defined by the user. Bandwidth is reserved and guaranteed on two redundant and diverse paths (RPR ringlets), making this class of service perfect for VoIP, video surveillance and IP-based teleprotection and SCADA applications.
- Class B service is reserved for applications less sensitive to jitter and delay such as SAN transport, file transfer and e-mail.
- Class C service is ideal for applications that do not require bandwidth guarantees such as Internet access or even leased capacity to external users.

Class A traffic always has priority over Class B and Class C traffic, thus insuring that critical Ethernet-based services required for personnel and service protection have the bandwidth needed for uninterrupted service.

Figure 4 shows network configuration in the event of a fiber failure. The RPR standard steering protection is used to examine service characteristics, reroute traffic around the fiber cut, and restore priority services within 50 ms.

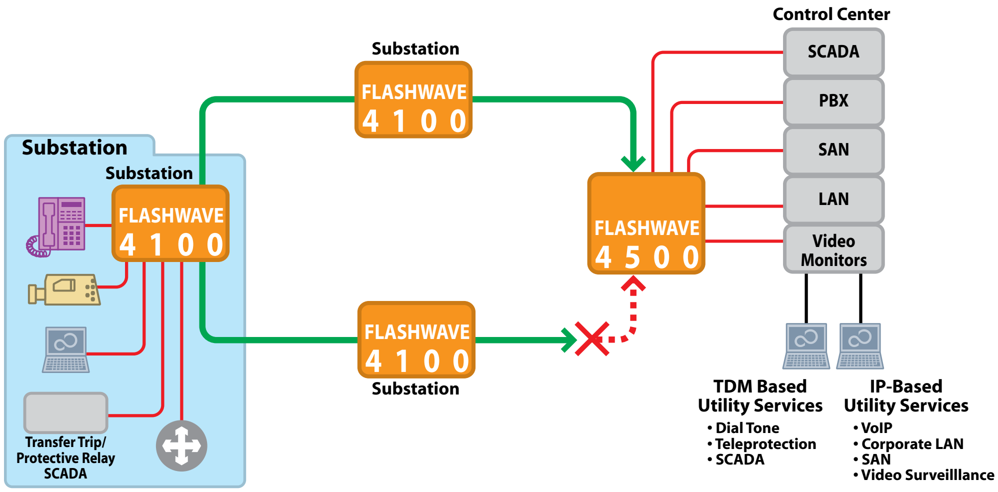


Figure 4: Multiservice Utility Network—Fiber Failure Condition

The FLASHWAVE 4100 MSPP and FLASHWAVE 4500 MSPP/MSSP also allow the creation of sub-networks so users can create multiple private rings for different departments within the utility. These sub networks can be assigned one of the three priorities, yet can be individually managed by each department.

Unified OAM&P

An advantage of TDM circuit provisioning and maintenance is that these circuits are usually point-to-point circuits. Early SONET systems had vendor-proprietary craft interfaces that eventually migrated to standards-based network management systems such as the Fujitsu NETSMART® 1500 NMS that manages all products in the Fujitsu FLASHWAVE product line. The NETSMART 1500 NMS provides point-and-click provisioning of traditional TDM services as well as broadcast and multipoint Ethernet-based services via a highly-intuitive GUI. The NETSMART 1500 NMS, coupled with the auto-discovery features of the FLASHWAVE 4100 MSPP and FLASHWAVE 4500 MSPP/MSSP makes assignment of RPR rings and sub-rings easy and manageable.

Summary

Evolving technology and end user voice and data needs are putting new demands on utility company's CI networks. Traditional TDM services need continued support and new Ethernet-based applications are being discovered every day. Utilities must maintain high levels of service reliability, yet control costs and extract maximum capacity out of their existing optical networks. The Fujitsu FLASHWAVE 4000 product family delivers the reliability expected for legacy TDM circuits and applies that reliability to new Ethernet-based services using RPR service prioritization and industry-standard QoS algorithms. The Fujitsu FLASHWAVE 4000 product family enables utility companies to get the most out of their existing communications network without sacrificing service reliability or increasing capital outlays for expensive overlay networks.

Acronym	Descriptor
CI	Critical Infrastructure
CWDM	Coarse Wave Division Multiplexing
DWDM	Dense Wave Division Multiplexing
E-LAN	Ethernet LAN
E-Line	Ethernet Private Line
ESCON	Enterprise Systems Connectivity
EVPL	Ethernet Virtual Private Line
FICON	Fibre Connectivity
GUI	Graphical User Interface
IED	Intelligent Electronic Devices
IP	Internet Protocol
LAN	Local Area Network
LCAS	Link Capacity Adjustment Scheme
LO-VCAT	Low Order Virtual Concatenation
MEF	Metro Ethernet Forum
MSPP	Multiservice Provisioning Platform
MSSP	Multiservice Switching Platform
NCC	Network Control Center
NMS	Network Management System
OAM&P	Operations, Administration, Maintenance and Provisioning
OC-n	Optical Carrier Signals in the SONET Hierarchy
PBX	Private Branch Exchange
QoS	Quality of Service
RF	Radio Frequency
ROI	Return on Investment
RPR	Resilient Packet Ring
SAN	Storage Area Networks
SCADA	Supervisory Control and Data Acquisition
SONET	Synchronous Optical Networks
TDM	Time Division Multiplexing
UPSR	Unidirectional Path Switched Ring
VCAT	Virtual Concatenation
VoIP	Voice over Internet Protocol
WAN	Wide Area Network

FUJITSU NETWORK COMMUNICATIONS INC.
2801 Telecom Parkway, Richardson, Texas 75082-3515
Telephone: (972) 690-6000
(800) 777-FAST (U.S.)
us.fujitsu.com/telecom